Supporting Information

A Smart Polymer with a high Sensitivity to Temperature and Humidity Based on Polyacrylamide Hydrogel Doped with Polyiodide

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Experimental Section.

Preparation of PPI from PAM: Acrylamide powders was dissolved in deionized water, in which the amount of acrylamide was 14.0 wt% relative to deionized water. The cross-linking agent (N, N'-methylenebisacrylamide, MBAA), thermoinitiator (ammonium persulfate, APS) and accelerator (N, N, N', N'-tetramethylethylenediamine, TMEDA) in molar ratios 0.028 mol%, 0.031 mol% and 0.152 mol%, respectively, relative to acrylamide monomer, were subsequently added into the solution. The mixture became a homogeneous and transparent at room temperature. The solution was transferred into a glass mold or a plastic tube (ϕ = 5 mm). The mold or plastic tube was then put on a heating stage at 40 °C or at RT for 12 h to obtain polyacrylamide (PAM) hydrogel. Then the mold or tube with hydrogel was put in an oven at 80 °C for 24 h to dehydrate. The dehydrated hydrogel was immersed in aqueous solution of polyiodide ions of definite concentration for 12 h to obtain hydrogel doped with polyiodide ions. Finally, PPI wires of certain length (10 cm) were obtained after lyophilizing and tailoring.

Device characterization and testing: The PPI was characterized using field-emission SEM (Carl Zeiss; ZEISS SUPRA-55). Raman spectra were recorded on a Horiba LabRAM HK Evolution Raman spectrometer with 532 nm wavelength incident laser light. Electrical properties of the thermistors were measured using an electrochemical workstation (CHI620E) equipped with a heating stage. The temperature was increased from 30 °C to 100 °C with a step of 10 °C. The device was stabilized on the stage for 3 min to achieve thermal equilibrium at each temperature point before electrical measurements. A manual device was used to adjust and monitor the humidity. A certain amount of dry or wet gas was used to decrease or increase the interior humidity of device.

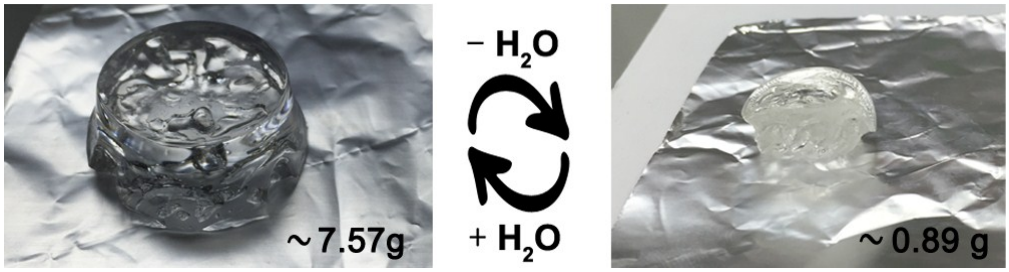

Figure S1. Digital photographs of the polyacrylamide hydrogel (7.57 g) and its dehydrated (0.89 g) form. PAM hydrogel can be rehydrated quickly and can be switched between these two forms several times by simple dehydration and hydration.

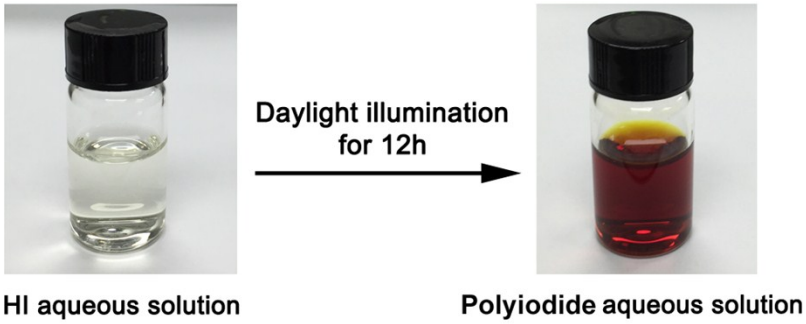

Figure S2. Digital photographs of the HI (1 M) and polyiodide aqueous solution.

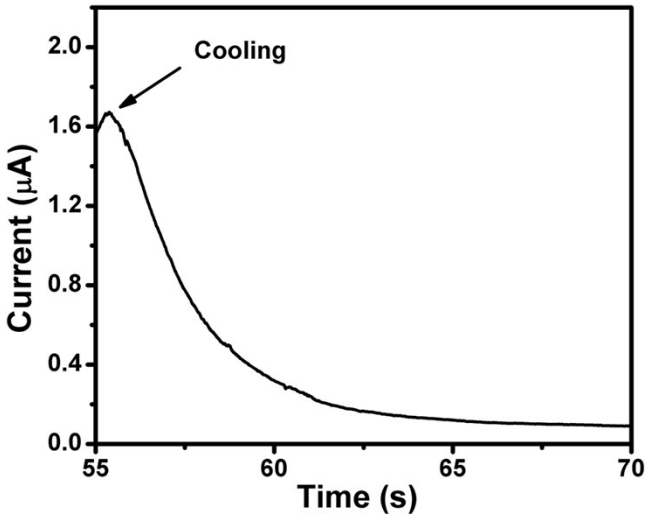

Figure S3. A single response for the PPI recovery process during one heating-cooling cycle.

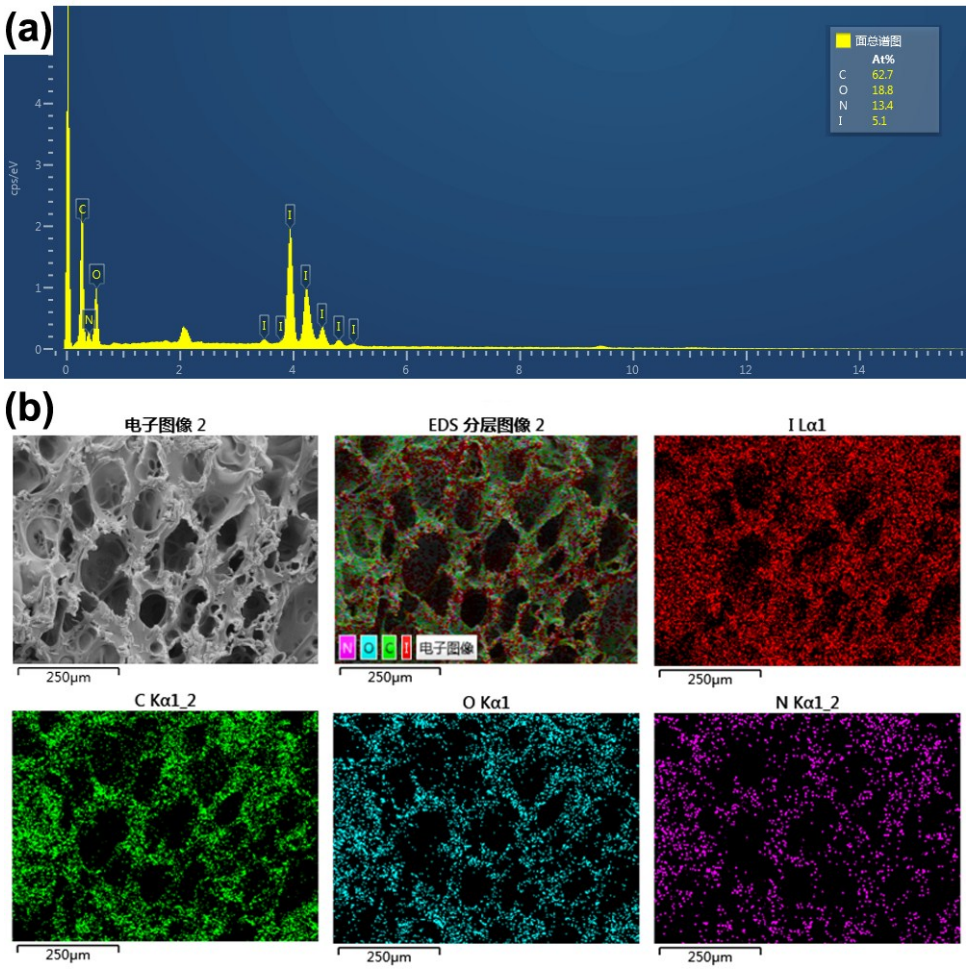

Figure S4. An EDX spectrum of PPI. (a) The atomic molar ratio of I is about 5.1%. (b) EDX element maps.

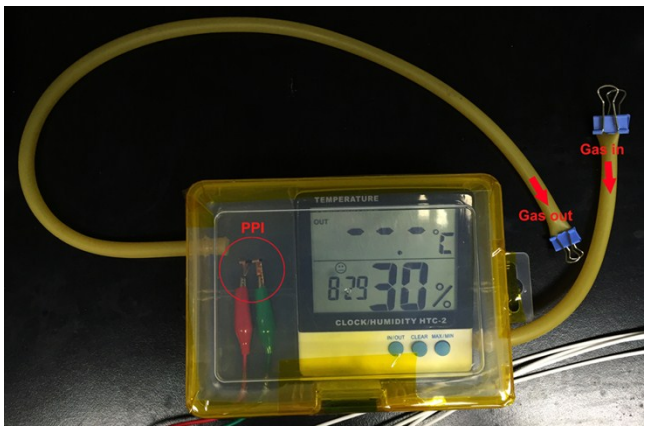

Figure S5. The photograph of a simple device used for testing humidity-response of PPI.